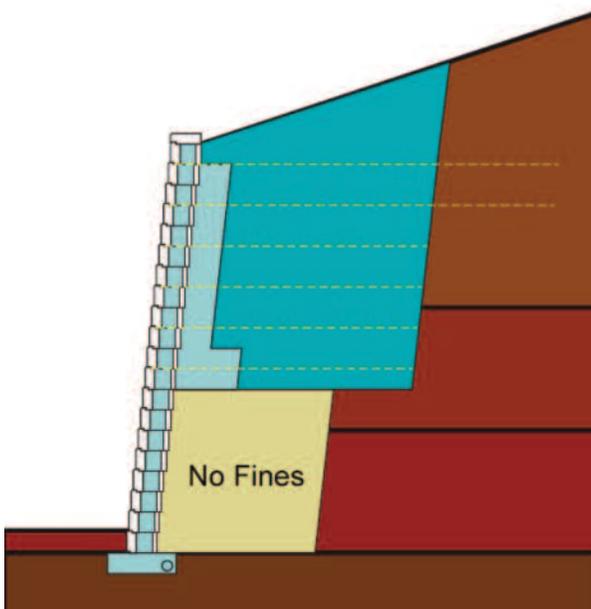
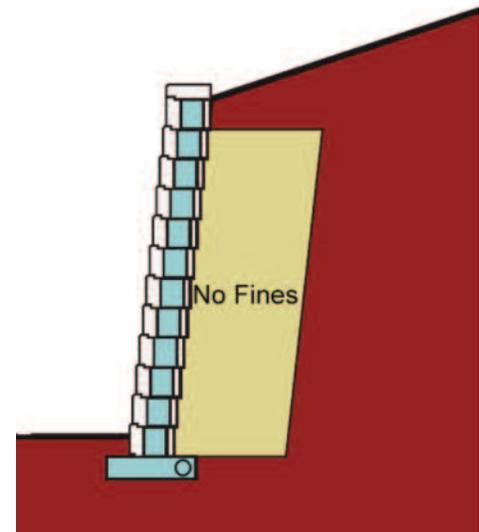
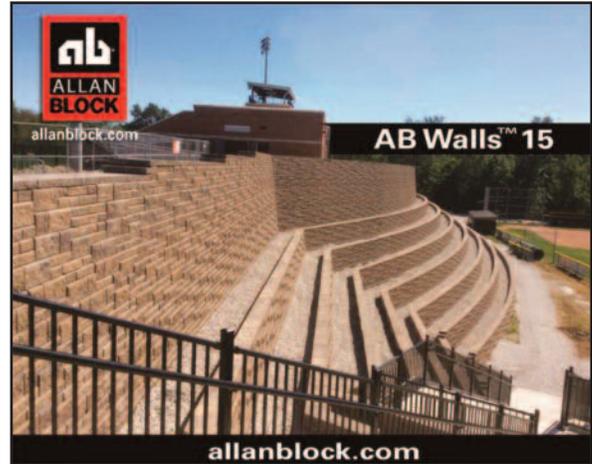




Designing with No Fines Concrete in AB Walls Design Software

Allan Block's AB Walls design software is the most comprehensive SRW design software available. Among its many functions and design capabilities is the ability to seamlessly design with No-Fines Concrete (NFC). It is not uncommon to have a site where traditional geogrid reinforced sections will not work. The SRW industry expects to see geogrid lengths equal to at least 60% of the total height of the wall. NFC can typically be used at roughly 30 - 40% of the wall height or less depending on the engineer's understanding of the site. This small percentage difference can, in many cases, solve the space limitation problem. NFC can also be used in complex projects where the wall section has come in contact with bedrock or other obstacles. In many cases it is too costly to remove the bedrock or the obstruction simply cannot be moved. In these cases, NFC is the perfect option. Using the Complex Composite Structure (CCS) function within AB Walls, the engineer can design the lower portion of wall with NFC and the upper portion as a traditional geogrid reinforced section. AB Walls and the CCS functions allow the designer to do these and more with NFC. A detailed discussion of Complex Composite Structures is later on in this tech sheet.

The following information is meant to be a User-Guide to using NFC within AB Walls. See the tech sheet on Building with No Fines Concrete for an in depth discussion on the uses and construction techniques of NFC on allanblock.com.



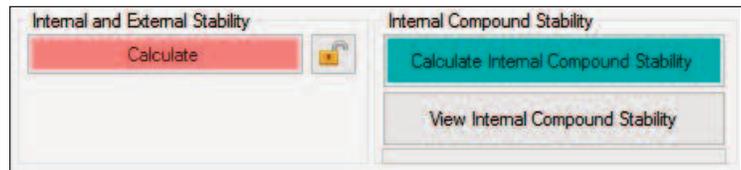
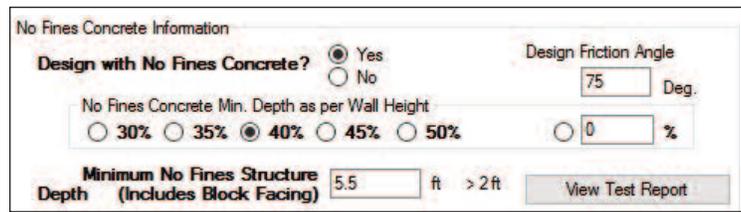
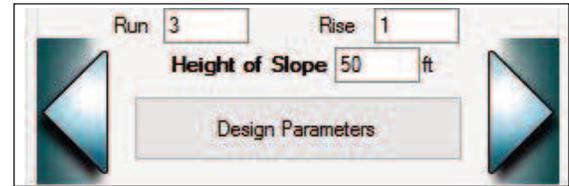
AB Walls NFC options

Users of AB Walls can design multiple cross sections along a wall's length and more importantly, they can have each cross section have its own characteristics depending on site constraints or surcharge loading. One section could be a traditional geogrid application and the next could be a NFC or even a Complex Composite Structure (CCS). AB Walls provides the flexibility the designer needs to create a compressive design for their most complicated sites.

To start a design in AB Walls Design Software, the designer must choose a wall block and a geogrid even if the entire wall is to be NFC. Then simply move through the Elevation, Plan and Panels screens as normal. These three screens allow the designer to input the geometry of the wall profile and plan view, and the ability to choose the individual wall lengths (called Panels) to create a design cross section for. As stated above, each panel section can be independent of the others.

Designing with No Fines Concrete

Once the designer accesses the cross section design screen, then click the “Design Parameters” button in the lower left corner of the screen and then click the “Design Options” tab on the following screen to access the NFC info. In the Design Options screen the designer can choose a variety of alternate design methods such as double block facing, NFC, they can manually input a desired Base size or set an alternate CCS bottom to top ratio. To use NFC, simply click “Yes” to the “Design with NFC” question. Notice the default depth ratio sets to 40%. AB Walls is a design tool and does not mandate the designer do their designs only one way. The designer has a choice of other percentages or they can manually enter a desired structure depth by percentage or by distance. They can also view a copy of the NFC shear test report completed by an independent testing lab. The test will be discussed later in this tech sheet. Once the designer has chosen NFC, simply click the Hide button and design the NFC section by clicking the “Calculate” button back on the design screen. Because this NFC section is now considered a deeper gravity wall, the only safety factors to be concerned with are the external sliding and overturning. Internal analysis may be accomplished using Internal Compound Stability (ICS). A detailed discussion of ICS calculations can be found in the ICS Tech Sheet as well as how it functions in NFC and CCS structures later in this tech sheet. AB Walls will tell the designer if the external safety factors are too low. Deepening the mass will increase the safety factor. To check ICS, click the “Calculate ICS” button and run the check. Again, if the safety factors are low, deepening the mass will increase them.



Specifics on How NFC is used in a Traditional SRW Design

External

The first calculations any designer does for an SRW project are the external calculations. They are by far the easiest to perform. For External Calculations (Sliding and Overturning) you simply compare the eccentricity of the overall weight and depth of the wall to the active earth pressure forces acting at the back of the wall. When the designer uses NFC in and behind the facing they are increasing the facing weight and depth and thus the resistance to the Sliding and Overturning forces. The deeper the NFC mass, the heavier and deeper the mass gets and thus the taller the wall can be built. This basic fact makes using an Allan Block facing with a NFC backfill the perfect option to the much more expensive “big block” products specified on some projects.

Internal

Internal calculations are specific to geogrid reinforced structures where the designer reviews the strength, the embedment length, and the spacing and relative position of each grid. Therefore, internal calculations are not run on gravity walls and especially not on NFC walls where the mass is a solid unit with no geogrid layers.

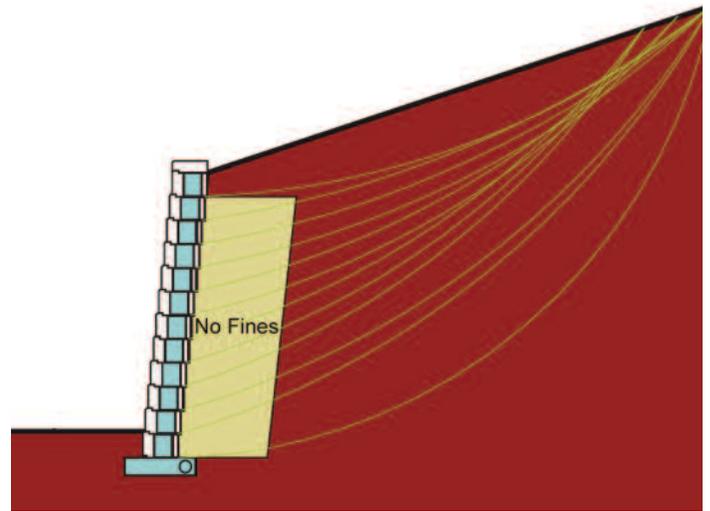
Bearing Capacity

Bearing calculations are run exactly the same way as a gravity wall. The biggest benefit to NFC as bearing is concerned is the larger footprint of a standard, block facing only, gravity wall. Therefore the deeper mass provides much more bearing stability to the structure than using just the facing in a typical gravity wall. Also, the weight of NFC is generally considered to be less than a traditional geogrid reinforced infill and thus provides less weight to be supported. Site soils or structural fill used in a traditional geogrid reinforced wall weighs roughly 120 pcf (1922 kg/m³), whereas NFC, which is very porous, weighs roughly 100 pcf (1602 kg/m³). These specific weights will vary but because of the voids, NFC will be less than structural fill gravel or site soils infill zones.

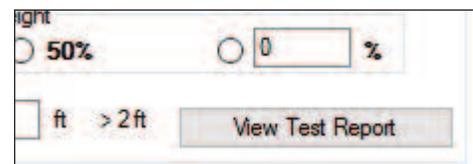
Building with No Fines Concrete

Internal Compound Stability

Internal Compound Stability (ICS) was introduced to the SRW industry in 2007 to bring a higher level of check to the internal structure of the reinforced soil mass. It uses a modified bishop global stability model to run slip arcs through the retained soils and the reinforced mass to determine if the geogrid layers are positioned correctly and have adequate strength and length. Bringing a global modeling approach into the SRW design has evolved the design approach significantly. While the traditional Internal and External calculations were and still are entirely separate, ICS effectively combines both into one set of Bishop global calculations. Why is this important to understand? An ICS design is so precise in its examination of the internal strength and stability of the reinforced mass, that if your wall section passes ICS, it will pass traditional Internal calculations as well. What this means to the designer is that if they choose to run traditional External and ICS calculations only, they can be justified in eliminating the old Internal calculations.



How does it work? Each ICS slip arc is carefully analyzed for sliding and resisting forces. The sliding forces come from anything that is above the slip arc like the weight of the soil, any external surcharges, and in some cases seismic loading. The resisting forces come from the soil's shear strength along the length of the circular arc, the interaction with the geogrid layers and the facing. When the designer uses NFC infill, the geogrid layers are no longer there. They are replaced with the tremendously high shear strength of the NFC mass. ICS uses the internal friction angle of the soil to determine the shear strength along the arc. To determine a conservative value for what the internal friction angle of a NFC mass should be in calculation, Allan Block Corporation contracted with Braun Intertec of Minneapolis to conduct independent research onto just how to determine this value. At first thought they were reluctant to take on this challenge because typical soil mechanics would say that the friction angle of a solid mass would be infinitely strong and thus 90 degree. After careful consideration, it was decided to run a lateral shear test on multiple samples, similar to how a soil sample would be tested. The full report can be found on our website or by using the link inside of AB Walls, in the NFC section by clicking the "View Test Report" button. Braun Intertec determined a conservative friction angle of NFC to be 77.2 degrees and an average compressive strength of NFC equal to 1400 psi (9.65 MPa). AB Walls defaults to an even more conservative 75 degrees but does allow the user to reduce that value as they see fit. Now that there is a determined friction angle for the NFC, the ICS calculations can be run as normal.



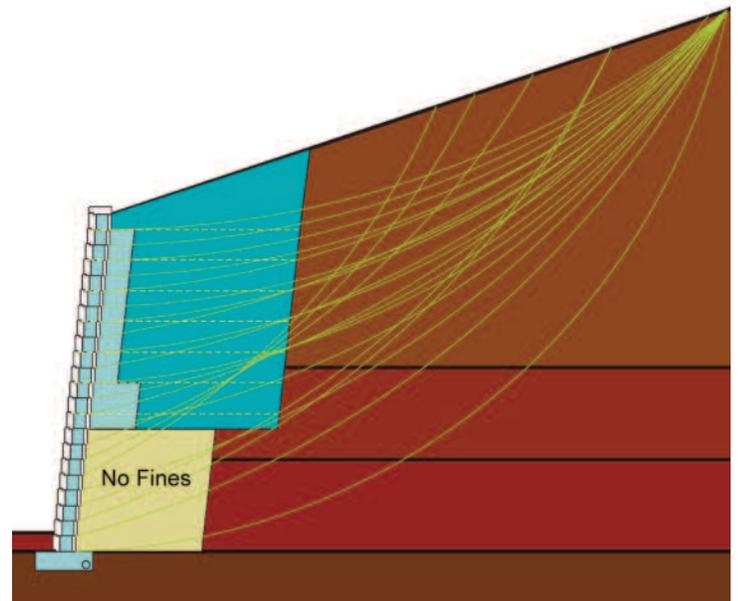
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It should be noted that Complex Composite Structure design would not be possible without the advent of ICS. Traditional Internal calculations simply would not allow for varied depth structures with varied soil or infill material types. Only a global modeling program could simulate this type of structure. Even today however, a global program can only go so far. They are unable to simulate the positive effect of a block face brings to the soil structure. AB Walls and ICS can.

Complex Composite Structure designs within AB Walls use a conservative approach to traditional External calculations and utilizes the precise analysis of ICS to verify the internal stability of the entire structure to provide the designer the confidence of overall structure stability.

For engineers and wall installers, NFC has proven to be a powerful option for many difficult site challenges. It is easy to design in AB Walls and even easier to use on the job site. For more information on NFC or to get a copy of the AB Walls Design Software, contact the Allan Block Engineering Department at engineering@allanblock.com.



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